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Impact of Praziquantel on Schistosoma mansoni Infection Rates and Associated Factors among Primary School Children in Teda, Koladiba, and Maksegnit Towns, Northwest Ethiopia

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Introduction

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Abstract

Background

Schistosoma mansoni is a significant public health concern worldwide, particularly affecting schoolchildren. The Ethiopian Ministry of Health promotes school-based single-dose praziquantel. However, this extensive implementation of mass drug administration might lead to selective drug resistance. Therefore, periodic assessment of the therapeutic efficacy of praziquantel is vital. Thus, we aimed to evaluate the impact of praziquantel on *S. mansoni* infection rates and associated factors among Primary School Children in Teda, Koladiba, and Maksegnit towns, Northwest Ethiopia.

Methods

A Multicenter cross-sectional study design was conducted in Teda, Koladiba, and Maksegnit Primary Schools from May to July 2024. A total of 657 schoolchildren were selected for the study. Approximately 2 grams of stool samples were collected and examined using the Kato-Katz technique. Children positive for *S. mansoni* received a single dose of praziquantel, and cure and egg-reduction rates were assessed within 21 days of treatment. The data were analyzed using SPSS.

Results

Out of 657 screened children, 10.5% (69/657) were infected with *S. mansoni*, with a higher prevalence among males and older children (56.6%). Sixty-three children were evaluated for praziquantel efficacy, showing a cure rate of 92.1% and an egg reduction rate of 90.1%. Most of the infections were of light intensity.

Conclusion

The prevalence of *S. mansoni* among schoolchildren in Teda, Koladiba, and Maksegnit was moderately endemic. The therapeutic efficacy of a single dose of praziquantel was satisfactory. However, health education is crucial for increasing awareness among children to avoid washing and swimming in open freshwater bodies.

Introduction

Schistosomiasis is an acute and chronic parasitic disease caused by flatworms of the genus Schistosoma (1). Seven species of Schistosoma have been identified as etiological agents of human disease (2).Among these, *S. mansoni* and *S. haematobium* are the most prevalent, causing intestinal and urogenital schistosomiasis, respectively (2). While both species pose public health concerns, *S. mansoni*

is the most common (3). It is a leading cause of morbidity and mortality in many developing countries (4).

Globally, approximately 780 million people are at risk of infection, with around 240 million cases and 280,000 deaths reported annually across 78 countries (5). Among these, 393 million are suspected cases, 54 million are confirmed cases, and 200,000 are deaths attributed to *S. mansoni* (6). Significant numbers of cases and deaths have been in the regions of South America, Asia, the Caribbean, and Africa (7). In Ethiopia, approximately 53.3 million people live where the disease is endemic (8). Among these, School Children (SC) account for 12.3 million individuals (9), with an estimated 5.01 million infected (10).

The life cycle of schistosomiasis begins when infected individuals release eggs into the water via feces or urine (11). Various factors associated with water contact activities, such as swimming, irrigation, washing clothes, and fishing, can influence the risk of infection in communities (12). The disease most affects SC; these age groups are highly vulnerable due to the habit of frequent water contact (12).

Different stages of the Schistosoma parasite play a role in its pathogenesis, but the egg stage is the most pathogenic (13). Long-term complications associated with schistosomiasis can include granuloma formation, periportal fibrosis, renal failure, bladder cancer, urogenital inflammation, as well as anemia and growth stunting (14). To combat this disease, the World Health Organization (WHO) recommends praziquantel (PZQ) as the first-choice anthelminthic therapy due to its safety, cost-effectiveness, minimal adverse effects, and effectiveness against all schistosome species (15).

The precise mechanism of action of PZQ is not fully understood (16); however, it is known to stimulate the transient receptor potential ion channel in the worm, leading to muscle contraction and paralysis due to increased calcium ion influx (17). Praziquantel also penetrates the worm's tegument, exposing the parasite to the host's immune response (18) and inhibiting glucose uptake, which immobilizes and can lead to the death of the parasites (19).

However, this ability may be affected by several factors, including the host (20), parasitic (21), and drug-related factors (22); the emergence of anthelmintic drug resistance following large-scale mass drug administration (MDA) of PZQ in the global (23). The resistance of *S. mansoni* to PZQ may indicate that genomic variations in the PQL-1 gene, particularly within the alpha-1 subunit of the tegumental calcium channel, may lead to mutations that inhibit PZQ binding, thereby reducing the drug's efficacy (24).

Furthermore, the transient receptor potential melastatin ion channel specific to PZQ in *S. mansoni* (SmTRPMPZQ) is a vital genomic target for PZQ response. The emergence of resistance to PZQ may be linked to genetic mutations within the PZQ binding pocket of SmTRPMPZQ, resulting in a loss of PZQ activity against *S. mansoni* (25). Additionally, the drug resistance in *S. mansoni* includes the efflux of drugs mediated by ATP-binding cassette (ABC) transporter proteins, specifically P-glycoprotein and multidrug resistance-associated proteins (26).

These factors challenge controlling and eliminating schistosomiasis transmission within communities (16). In light of these issues, the current study aims to assess the therapeutic efficacy of praziquantel and the factors associated with the prevalence of *S. mansoni* infection among primary school children in Teda, Koladiba, and Maksegnit Towns, Northwest Ethiopia.

Methods and materials

Study Design, Setting, and Period

A multicenter cross-sectional study was conducted from May to July 2024 in selected areas, specifically Teda, Koladiba, and Maksegnit primary schools, located in Northwest Ethiopia. Koladiba Town is situated in the central Gondar zone of the Amhara Region, 729 km north of Addis Ababa and 35 km from the historic city of Gondar. The altitude in this area ranges from 1750 to 2100 meters above sea level. According to the 2007 Ethiopian census, the population of Koladiba is approximately 263,000 people. The area is close to Lake Tana, and the majority of its residents rely on subsistence farming, particularly through irrigation.

While Maksegnit Town, also located in the central Gondar zone of the Amhara Region, is 621 km from Addis Ababa and 40 km from Gondar town. The geographical coordinates of Maksegnit are approximately 12.3° to 13.8° N latitude and 35.3° to 35.7° E longitude, with an elevation of 2,220 meters above sea level. Due to the 2007 census conducted by the Central Statistical Agency of Ethiopia, the district has an estimated population of 222,990. Like Koladiba, Maksegnit is situated near Lake Tana and features primary schools located close to the river.

The Teda Town is located 698 km from Addis Ababa, 169 km from Bahir Dar, and 29 km from Gondar. It is positioned at coordinates 11° 20' 57.93" N latitude and 37° 58' 42.45" E longitude. According to the 2007 census, Teda has an approximate population of 11,234 residents, with elevations ranging from 1,800 to 2,600 meters above sea level. The annual rainfall in this area varies from 771 mm to 1,160 mm, while temperatures range from 22°C to 29°C. Key water sources include the Megech and Angecha Rivers. These water bodies in the study areas are likely contributors to *S. mansoni* infections due to their use for bathing, washing, and other daily activities.

Source population

All school children attending their education in the primary schools in Teda, Koladiba, and Maksegnit were considered the source population for this study.

Study population

Volunteer children aged 5–15 years who had confirmed *S. mansoni* infection and attended the selected schools during the study period were considered the study population for this study.

Inclusion and Exclusion Criteria

Volunteer school children aged 5 to 15 years who can provide the required stool samples and assent to participate in the efficacy assessment. Children who provided insufficient or diarrheal stool samples, those who received anthelminthic treatment within six months of the study, children with severe medical conditions (gastrointestinal diseases), those who vomited within four hours after drug administration, and children co-infected with intestinal helminths were excluded from the study.

Sample size determination

According to WHO guidelines, to evaluate the efficacy of the anthelminthic drug (PZQ), a minimum of 50 microscopically confirmed *S. mansoni*-infected children must be included in the study (27). Based on this guideline, the required sample size was calculated to obtain 50 positive children. The number of children to be screened was determined by considering an 80% compliance rate, and the previously reported *S. mansoni* prevalence was 10.4% (28) by using this formula: A total of 662 schoolchildren participated in this study, including 10% of the non-response rate.

$$\mathrm{Numberofchildrentobescreened} = \frac{\mathrm{Numberofinfectedchildren}}{\mathrm{ComplianceratexXprevalence}}$$

Sampling technique

The total sample size was proportionally allocated to each school and grade level based on the number of children enrolled in the selected schools. Therefore, 215 data from Teda, 219 from Maksegnit, and 228 from Koladiba primary schools were collected, respectively. Participants for the initial screening were from each class (Grades 1 to 8) using a systematic random sampling technique, with class rosters serving as the sampling frame.

Operational definition

Cure rate

refers to the percentage of infected individuals who receive a single dose of PZQ and successfully eradicate the parasite after 21 days of treatment (29).

Egg reduction rate

the relative reduction in fecal egg counts after treatment of a single dose of PZQ (40mg/kg) compared to the pre-treatment egg count by using KK (30).

S. mansoni infection intensity: light excreted 1–99 parasite eggs per gram (EPG) of feces, moderate between 100–399 eggs per gram of feces, and heavy greater than or equal to 400 eggs per gram of

feces (31).

School children

children aged 5–15 years, who are eligible to attend primary school (31).

Socio-demographic data and data collection tools

Initially, a pretested semi-structured questionnaire was developed in English language, translated into the native Amharic, and then back-translated into English to ensure the accuracy of the translation. The questionnaire encompassed various aspects, including the socio-demographic, behavioral, and other health-related data of the participants. The questionnaire was piloted among 5% of children at Tiwld Amare Primary School in Teda town two weeks before data collection. Four data collectors were assigned to the school to survey under the supervision of the principal investigator. This process begins with obtaining written permission from the school directors to recruit children and obtaining verbal assent from the children. Before the interviews, explain the purpose of the study to both the children and their teachers. The demographic and behavioral data were collected by trained health officers and medical laboratory technologists using a structured questionnaire through face-to-face interviews with the children. After the interview, the data collectors asked each participant to collect approximately 2 grams of fresh stool specimens; this collection process was repeated after 21 days of treatment. Children confirmed that *S. mansoni* had brought their parents or legal guardians to the school and obtained informed consent from the parents or legal guardians.

Laboratory method

The World Health Organization recommends KK techniques for diagnosing and quantifying the parasite in terms of eggs per gram. This process begins by obtaining written permission from the school directors to recruit children and by obtaining verbal assent from the children. The data collector asked the children for demographic data and created awareness about the stool sample collection process. Each participant received a uniquely labeled, clean, dry, and leak-proof container. They were instructed to collect approximately 2 grams of a fresh stool specimen while at school. This procedure was repeated at the follow-up after treatment. Children who provided insufficient samples were encouraged to submit another. Inadequate and diarrheic samples were rejected at the schools.

The collected specimens were properly and promptly transported to the nearby Teda Health Sciences College laboratory for processing. At the laboratory, freshly collected stool samples were sieved through a fine wire mesh with a pore size of 200 μm to remove large particles. The filtered stool remaining on the mesh was scraped off using a plastic spatula. A template was placed on a microscope slide, and the hole was filled with the sieved feces, which accounts for 41.7 milligrams of stool. The template was then removed. The fecal sample was covered and pressed with cellophane soaked in glycerol-malachite green solution overnight. These KK thick smear slides were left to clear for 24 hours. This process facilitates

the detection and quantification of *S. mansoni* eggs, as well as the presence of other intestinal parasites. The examination was conducted using a light microscope. The EPG was calculated by multiplying the number of eggs per slide (EPS) by a correction factor.

Drug administration

Children who tested positive for *S. mansoni* were given high-carbohydrate snacks (biscuits) before receiving a single dose of PZQ (40 mg/kg) to enhance drug bioavailability. The drug, branded as Biltricide, was manufactured by Bayer Pharmaceuticals (Batch No. A6c153, expiration date: 03/2027) and purchased from a private pharmacy. The drug administration took place at each school, and the children were monitored under direct observation for approximately four hours to identify potential complications.

Follow-up survey

Initially, treated children were asked to provide a second stool specimen, which was examined using the KK technique following the same procedures as the baseline after 21 days of post-treatment to assess PZQ efficacy. The children absent from school on the follow-up day were to wait one or two additional days to collect their specimens.

Outcome measures

The study outcomes were meticulously analyzed, with a primary focus on the prevalence of *S. mansoni* infection. Additionally, the therapeutic efficacy of PZQ is a secondary outcome. These were measured using the fecal ERE and the CR. The following formulas were used to calculate:

$$ERR = (1 - \frac{\mathrm{Arithmeticmeaneggcountsatfollowup}}{\mathrm{Arithmeticmeaneggcountsatbaseline}}) * 100$$

$$CR = \frac{\mathrm{Numberofnegativechildrenaftertreatmentwhowerepositiveatbaseline}}{\mathrm{numberofpositivechildrenbeforetreatment}} * 100$$

Quality control and management

To ensure the data quality, the data collectors received training, and children were instructed to avoid providing insufficient samples and to ensure that the stool was free from contamination with soil and urine. Each stool sample was cross-checked with its unique identification number and immediately transported to the laboratory using a cold box. Standard operating protocols were strictly followed during the KK tests. All KK reagents, including glycerol and malachite green, were verified for expiration dates before use.

Additionally, the packaging of PZQ was inspected for physical damage, storage conditions, and expiration dates before administration. The laboratory technologists independently examined all smears, and 10% of the slides were randomly selected and re-checked by other senior laboratory technologists,

ready to manage discordant results. The variance inflation factors were calculated to check multicollinearity among independent variables. Check the normality of data using visual and statistical methods.

Data Analysis and interpretation

Initially, the data were entered into Epi Data version 4.7 and subsequently exported to the Statistical Package for the Social Sciences (SPSS) version 25 for further analysis. Descriptive statistics were used to summarize the baseline characteristics of study participants. The fecal CR and ERR were employed to evaluate the efficacy of PZQ. The arithmetic mean (AM) was used to express ERR. The Mann-Whitney U test was used to compare the mean eggs per gram of Males vs. Females and age 5–9 vs. 10–15. Pearson's Chi-square test assessed associations between potential risk factors and CR. Further bivariate logistic regression analysis identified factors associated with *S. mansoni* infection, including all variables with a p-value < 0.25 in the multivariable logistic regression analysis. A p-value of < 0.05 was deemed statistically significant.

Results

Baseline characteristics of the study participants

At the beginning of the study, 662 schoolchildren were screened to provide stool specimens for assessing the prevalence of *S. mansoni* infection and the efficacy of a single dose of PZQ. Remarkably, 99.2% of SC provided sufficient fresh stool samples for diagnosing *S. mansoni* infection using the KK method. According to the KK results, 69 Children (10.5%) have *S. mansoni* infection. Three weeks post-treatment, 63 participants completed their follow-up for the final PZQ efficacy analysis against *S. mansoni* infection. Of these, 58 SC (92.1%) were cured (Fig. 1**).**

Socio-demographic and behavioral characteristics of the study participants

Among the 657 schoolchildren, most were male, 51%. The mean age of the SC was 10.05 ± 2.3 years (mean ± standard deviation). Regarding the behavioral characteristics of the participants, 70.8% reported a habit of swimming, 70.6% washed their clothes in the river, and 59.2% frequently crossed the river barefoot. Both bivariate and multivariable logistic regression analyses revealed that washing and swimming habits were significantly associated with the prevalence of *S. mansoni* infection (p < 0.05) (Table 1).

Table 1
Bivariate and multivariable logistic regression analysis of demographic and behavioral characteristics of the study participants in Teda, Koladiba, and Maksegnit towns, Northwest Ethiopia, 2024

Variables Categories		Participants n (%)	Bivariate COR (95%, CI)	*P* value	Multivariable AOR (95%, CI)	*P* value
Sex	Male	336 (51.1)	0.78 (0.47–1.29)	0.345		
	Female	321 (48.9)	1			
Age	5–9	313 (47.6)	1			
	10–15	344 (52.4)	0.83 (0.50–1.16)	0.465		
Residence	Urban	305 (46.4)	1			
	Rural	352 (53.6)	0.99 (0.60–1.65)	0.993		
Grade level	1–4	336 (51.1)	1			
	5–8	321 (48.9)	0.76 (0.46–1.25)	0.276		
Swimming habit	Yes	465 (70.8)	2.47(1.49–4.10)	0.000*	1.85 (1.03–3.31)	0.039*
	No	192 (29.2)	1			
Washing clothes in river	Yes	464 (70.6)	2.45 (1.48–4.06)	0.001*	1.82 (1.02–3.26)	0.044*
	No	193 (29.4)	1			
Crossing river on bar foot	Yes	389 (59.2)	1.29 (0.78–2.13)	0.319		
	No	268 (40.8)	1			
Parents educational status	Literate	337 (51.3)	1			
	Illiterate	320 (48.7)	0.75 (0.45–1.24)	0.265		
Total		657 (100)				

COR: crude odds ratio; AOR: adjusted odds ratio; CI: confidence interval; 1: reference;

*: Significant association at $p < 0.05$.

Prevalence of Schistosoma mansoni and baseline infection intensity

Among the total screened SC using the KK technique, 69 participants tested positive for *S. mansoni* infection; the overall prevalence rate was 10.5%. The prevalence was notably higher (56.6%) among males and older children (Table 2). Most school children had light infection intensity, accounting for 47.6%.

Table 2
Prevalence of Schistosoma mansoni infection among primary school children in Teda, Koladiba, and Maksegnit towns, Northwest Ethiopia, 2024

Variables	Category	Frequency	Positive n (%)
Sex	Male	336	39 (11.6)
	Female	321	30 (9.3)
	Total	657	69 (10.5)
Age	5–9	313	30 (9.6)
	10–15	344	39 (11.3)
	Total	657	69 (10.5)

Therapeutic efficacy of a single dose (40 mg/kg) of praziquantel

The World Health Organization recommends an evaluation of the therapeutic efficacy of PZQ through parasitological cure and egg reduction rates (27). Among the total screened participants, 63 *S. mansoni*-infected SC were enrolled for final analysis. Three weeks after receiving a single dose (40 mg/Kg) of PZQ, five infected children were still microscopically confirmed positive *for S. mansoni.* The parasite ERR was expressed as the AM among infected participants, with a baseline intensity of 243 ± 196 EPG (mean ± standard deviation). This mean was reduced to 24 EPG three weeks post-treatment. Following treatment, the overall CR and ERR of PZQ among *S. mansoni*-infected individuals were 92.1% (95% CI: 82.4–97.4) and 90.1% (95% CI: 86.4–93.8), respectively. However, baseline infection intensity with CR and age of the study participants with ERR were significantly associated with $p < 0.05$ (Table 3).

Table 3
Praziquantel CR and ERR with associated factors among S. mansoni-infected primary school children in Teda, Koladiba, and Maksegnit towns, Northwest Ethiopia, 2024

Cure rate and Egg reduction rate							
Variables Categories		Total n (%)	Cured n (%)	χ^2	*P*-value	ERR (%)	*P*-value
Sex	Male	37 (58.7)	34 (91.9)	0.004	0.952	91.0	0.056
	Female	26 (41.3)	24 (92.3)			88.54	
	Total	63 (100)	58 (92.1)			90.1	
Age	5–9	24 (38.1)	22 (91.7)			88.46	
	10–15	39 (61.9)	36 (92.3)	0.008	0.927	90.9	0.039
	Total	63 (100)	58 (92.1)			90.1	
Baseline infection intensity	Light	30(47.6)	30 (100)				
	Moderate	23(36.5)	23 (100)				
	Heavy	10(15.9)	5 (50)	28.784	0.000		
	Total	63(100)	58 (92.1)				

ERR: egg reduction rate; χ^2: chi-square test.

Discussion

Schistosomiasis is the most prevalent helminthic disease in Ethiopia. Particularly affecting schoolchildren (4). The prevalence of *S. mansoni* infection among SC in our study areas was 10.5% (95% CI: 8.3–13.1). These findings were in line with studies conducted in western Côte d'Ivoire (9.5%) (32), Southwest Nigeria (9%) (33), Tanzania (8.7%) (34), and Southwest Ethiopia (8.4%) (35). However, it was higher than reports from Rwanda (6.5%) (36), South Sudan (6.1%) (37), and Debre Tabor (1.8%) (38).

Variations in prevalence can be attributed to geographical factors and climate conditions (39). For example, Debre Tabor, located at an elevation of 2,706 meters and with an average temperature of 14.8°C, has less favorable conditions for the intermediate host (snails) compared to our study areas, which have an average temperature of 25°C and ongoing irrigation projects that promote snail breeding (40). Additionally, a previous study noted that the national neglected tropical disease control program was established in Rwanda in 2007, eight years before Ethiopia (2015). The earlier implementation in Rwanda may have led to an underestimation of disease transmission (41). Sustainable community-based interventions in South Sudan could further help reduce prevalence rates compared to our study area (37).

Compared to other regions, our prevalence findings were lower than those reported from Ghana (46.9%), Uganda (18.7%), and various parts of Ethiopia, such as Northwest and Southwest Ethiopia (28.7% and 37.9%). These differences may be due to active deworming campaigns targeting SC in Teda, Koladiba, and Maksegnit primary schools, where health extension workers provide education on schistosomiasis prevention and promote proper sanitation practices (Source: Teda, Koladiba, and Maksegnit Health Center).

Variations in sample size and diagnostic methods also contribute to differences in prevalence rates. Studies with larger sample sizes can better represent the population. For example, a study in the Mayuge district, Uganda, with 1,617 participants, reported a higher prevalence of *S. mansoni* (42). Additionally, previous studies using double KK smears per individual child likely reported higher prevalence rates than our study, which utilized single smears (43).

Our findings indicated that *S. mansoni* infections were more prevalent among males and older children aged 10 to 15, although sex and age were not statistically associated with infection rates. This aligns with studies from Tanzania (34), Egypt (44), and Ethiopia (7, 23, 45, 46). The male and older (10–15) aged SC had the opportunity to contact freshwater bodies because they were old enough to support their families in outdoor activities like agriculture (irrigation). They also have greater freedom to engage in recreational activities, including swimming and washing, which may increase their exposure to the parasite (12).

In contrast, female children spend less time near bodies of water, as they often remain home to fulfill household duties under family supervision. When they come into contact with water, females mostly use soap for washing, which has a molluscicidal effect that may reduce the risk of infection (47). This might necessitate gender-targeted health promotion initiatives to raise awareness about the potential dangers of schistosomiasis associated with contact with fresh water. Children who swam in rivers exhibited a higher prevalence of *S. mansoni.* Water-contact activities can increase the risk of infection, with those who washed or swam in rivers being 1.8 times more likely to be infected. This finding is consistent with other studies demonstrating a significant correlation between infection rates and interactions with freshwater bodies (1, 46).

The administration of a single dose (40mg/kg) of PZQ had a satisfactory effect on the clearance of fecal eggs among *S. mansoni*-infected individuals after three weeks of treatment. The overall CR of PZQ was 92.1% (95% CI: 82.4–97.4). This result is consistent with studies conducted in northeast and northwest Ethiopia, which reported CRs of 91.7% and 90%, respectively (45, 48). However, it is lower than findings from Rwanda (97.9%) and Southwest Ethiopia (99.1%) (23), while higher than reports from Tanzania (81.2%) (49) and various regions in Ethiopia (73.6% and 80.9%) (50, 51).

Factors influencing PZQ efficacy include parasite factors, host characteristics, drug dosage, and diagnostic methods (52). In Rwanda, a higher CR was observed due to a predominance of light infections (36). In contrast, high infection intensities can reduce PZQ effectiveness (49–51). Our study indicated that younger children had a lower CR than older children, although the difference was not

statistically significant. This aligns with previous studies that found lower CRs among younger age groups, likely due to lower drug dosages based on weight (53).

Interestingly, CR among females was slightly higher than among males (92.3% vs. 91.9%); this may be due to a higher proportion of light infections among females. The variation in CR and ERR may also be attributed to differences in the brands of praziquantel used. A study conducted by Haile in 2012 indicated that the CR of PZQ was lower due to the use of the Distocide brand of the drug. Additionally, the children did not receive a diet before the drug administration, which may have further affected the treatment outcomes by decreasing the drug's bioavailability (50).

Higher CR and ERR were observed with subsequent doses of PZQ, likely due to the initial dose's limited activity against immature worms. However, subsequent doses administered effectively targeted the worms as they matured into adulthood (29). This concept is supported by studies in Uganda and Egypt, indicating that double dosing improves efficacy (44, 54).

The post-treatment duration for measuring CR also impacts the results. A longer duration may allow for reinfection or maturation of juvenile schistosomes into adults, leading to egg production and lower CR. Previous studies reported CR of 89.1% and 87.5% at four and eight weeks post-treatment, respectively (7). The KK technique's lower sensitivity in detecting eggs, especially in low worm burdens, may contribute to overestimating CR (55). A study in Côte d'Ivoire demonstrated significant differences in CR when using various diagnostic methods, highlighting the need for more sensitive techniques (56).

In addition to CR, ERR is a critical indicator of PZQ efficacy. Our study showed a significant reduction in parasite load. Specifically, the average egg count of *S. mansoni* in stool samples decreased from 243 EPG at baseline to 24 EPG three weeks post-treatment. The overall ERR was 90.1% (95% CI: 86.4–93.8), slightly higher than the WHO minimal threshold (27). This outcome is consistent with earlier reports from Ethiopia, which reported ERR of 86.8% and 93.5% (3, 53). However, it is higher than findings from the Amhara region, which reported an ERR of 79.46% in Senbetie (57) and 78.3% in Sanja (19). Variations in ERR may be due to initial infection intensity. Studies reporting higher ERR involved a significant proportion of light infections, which respond better to treatment (58). Our study found that younger children had a lower ERR than older children. This outcome is consistent with a prospective cohort study in southern Ethiopia (49). On the other hand, the current finding of ERR was lower compared to other studies performed in Tanzania (95%) (49), Jimma (99.9%) (23), and Sanja (99.5%) (45). These variations may be due to differences in initial infection intensity, the diagnostic techniques employed, and extended follow-up time after treatment, which could account for the discrepancies between the current and previous studies (49).

Limitations of the study

Our study used a multicenter cross-sectional study design, which may lead to either an overestimation or underestimation of prevalence because it represents the current situation and may not sufficiently consider changes over time. Additionally, relying on a single sample and the KK technique for baselines

and post-treatment *S. mansoni* egg counts may lead to an underestimation of light-intensity infections (prevalence) and an overestimation of the CR and ERR.

Conclusion and recommendation

Based on KK results, the prevalence of *S. mansoni* infection was a significant public health challenge. The therapeutic efficacy of a single dose (40mg/kg) of PZQ, as measured by CR and ERR, was satisfactory for treating *S. mansoni*, meeting the WHO threshold. Several factors complicate efforts for elimination and control, such as washing and swimming habits, which are linked to exposure to infected water sources and may significantly contribute to the increasing prevalence.

To effectively combat *S. mansoni* infections, we recommend that the Ethiopian Ministry of Health maintain a deworming program. The Megech Dam project poses a future risk of increased snail reproduction and schistosomiasis transmission. Comprehensive interventions (including promoting hygiene practices) and multisectoral efforts are crucial to improving health outcomes before the dam becomes operational. Future research should employ sensitive diagnostic techniques and community-based studies to assess the prevalence. Additionally, ongoing evaluations of drug efficacy, particularly regarding PZQ resistance genes, are vital for managing drug resistance and controlling *S. mansoni* infections at the community level.

Abbreviations

CR: Cure Rate

EPG: Eggs per gram

ERR: Egg Reduction Rate

KK: Kato Katz

MDA: Mass Drug Administration

MoH: Ministry of Health

NTDs: Neglected Tropical Diseases

PZQ: Praziquantel

SC: School Children

WHO: World Health Organization

Declarations

We, the authors, confirm that this manuscript is our original work and has neither been submitted for publication nor published elsewhere. Furthermore, all authors have read and approved the final version of the manuscript, had full access to all of the data in this study, and take complete responsibility for the integrity of the data and accuracy of the data analysis.

Ethical consideration

The research and ethics committee of the University of Gondar reviewed and approved the study protocol (Ref. No. SBMLS/741/2024). Written permission was obtained from the school directors. Study participants, along with their guardians or parents, were informed about the aims of the study and data collection procedures. Each participant voluntarily participated in the study and had the right to withdraw their consent at any time. Additionally, verbal assent was obtained from the children, while signed informed consent was secured from their parents or legal guardians. Every child infected with *S. mansoni* received a single dose (40 mg/kg body weight) of PZQ as treatment by a health officer. Children infected with other parasites, those who vomited during drug administration, and those who were positive at follow-up, received appropriate drugs through the referral link with Teda, Koladiba, and Maksegnit Health Center. The study was conducted in accordance with the Declaration of Helsinki.

Clinical trial

Not applicable

Consent for publication

Not applicable

Availability of data and material

The data supporting the findings of this study are not deposited into the publicly available repository. The data used in this study are available from the corresponding author and will be accessible upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Supplementary information

SI Table: Variable assessment questionnaire (PDF)

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Figures

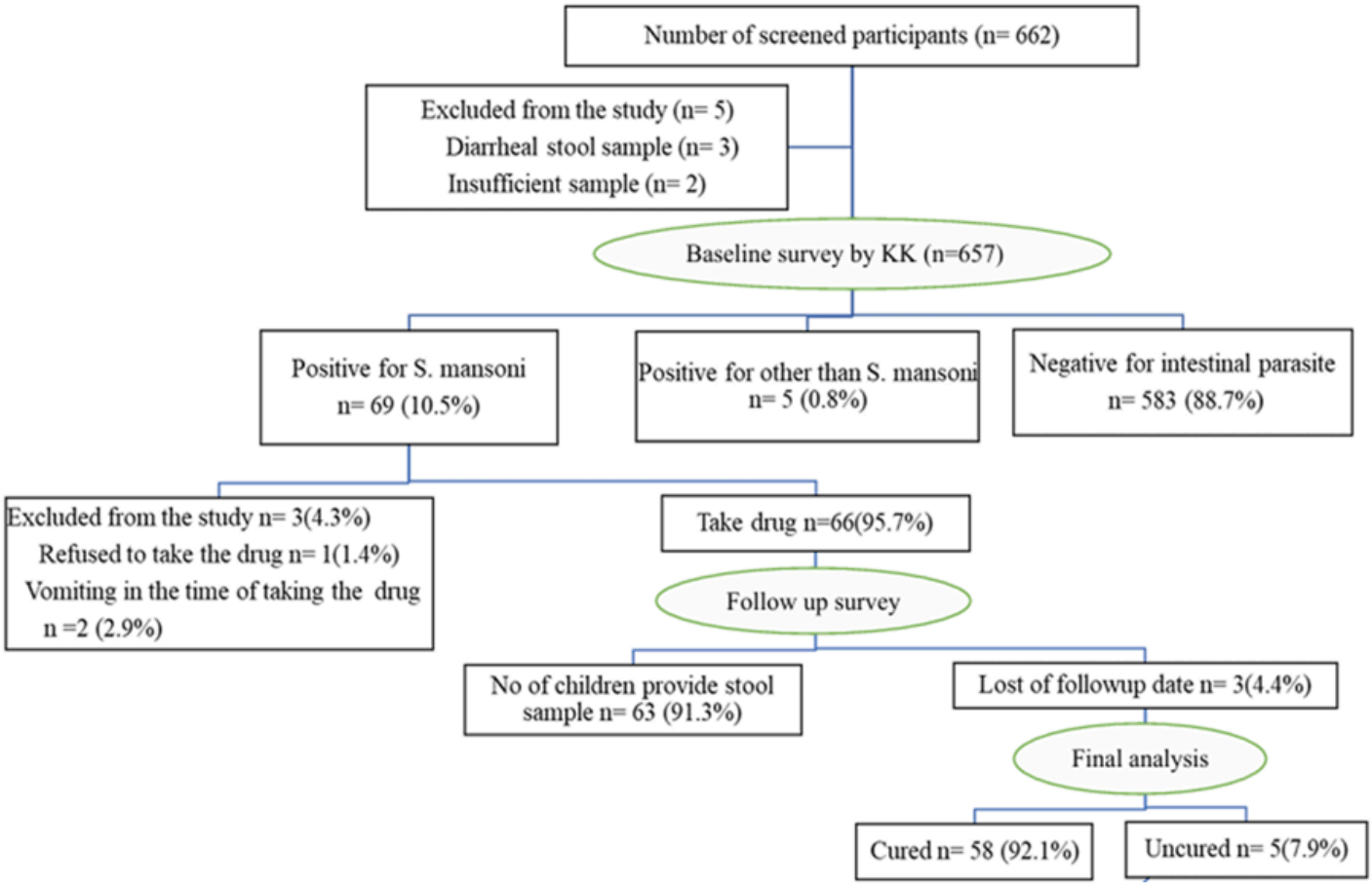


Figure 1

Diagrammatic representation of study participant enrolment for the Impact of Praziquantel on *Schistosoma mansoni* Infection Rates.

Supplementary Files

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